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A low-cost GNSS-R system based on software-defined-radio

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On one side Global Naviation Satellite System (GNSS) users try to avoid multi-path signals, i.e. reflections which propagate into the geodetic antenna, as this effect can bias the results. On the other side, the remote sensing community has an increasing interest in analyzing such reflections as they provide valuable information about the physical characteristics of the reflection area. This technology is called GNSS- Reflection (GNSS-R) and operates usually with two antennas in order to monitor direct and reflected signals. One up-looking (RCHP) and one down-looking (LHCP) antenna is deployed at the same site and analysis of the differential delay and/or the cross-correlation function w.r.t. to delay and Doppler shift allows to deduce the physical properties of the scattering surface.
In order to develop a GNSS-R off-the-shelf system RHCP and LHCP L1 active patch antennas are utilized together for this purpose. Instead of equipping the antennas with GNSS receivers, signals are sampled directly in the RF and sent to a PC over a Gigabit ethernet connection. This allows us to implement the system as a software radio using readily-available, low-cost RF hardware and commodity processors. The software backend and the corresponding hardware enables us to sample and process data with sampling rates of up to 25 MHz per antenna. Since all components are provided under GNU license a flexible and cheap implementation of the GNSS-R solution is anticipated. Additionally, delay-only information or Delay/Doppler maps can be extracted by the usage of GPUs, which help to reduced the computational load for the CPUs.
Field tests are being carried out with the two GNSS antennas mounted on a horizontal pole which is put on a 60m high telecommunication tower located NICT's headquarter in Koganei, Tokyo. After first tests under the local environment conditions it is also thought to deploy the system on the seaside in order to test its usefulness for sea level monitoring.